Item 5: claims 2 and 3 were rejected under 35 U.S.C. 103(a) as being unpatentable over Takeuchi et al. in view of Seefeldt et al. (U.S. Patent No. 6,021,675 and Seefeldt hereinafter) and White (U.S. Patent No. 5,006,749 and White hereinafter).

Item 6: Applicant's arguments with respect to claims 1 - 3, presented in Applicant's preceding Response communication filed on May 15, 2002, were apparently considered by the Examiner, but were stated as being moot in view of the new ground(s) of rejection.

Formal drawings will be submitted at the time of paying the issue fee.

By this Response, the Applicant has amended four paragraphs of text of the specification; two paragraphs on page 24, and one paragraph on each page 34 and 37. Independent claim 1 (device corresponding to the method recited by claim 29) and claim 29 (method corresponding to the device recited by claim 1) have been amended. Attached herewith is a marked up version, captioned "Version With Markings To Show Changes Made", of the changes made to the specification and claims by the present Amendment.

Briefly, the present invention relates to a piezoelectric device featuring a first element of porous silicon, a second element attached to, or integrally formed with, the first element, and at least two electrodes in electrical contact solely with the first element of the first and second elements, such that subjecting the first element to an electric potential via the at least two electrodes results in a strain induced by the first element on the second element. A corresponding method of inducing a strain by a first element of porous silicon on a second element, features the steps of attaching to, or integrally forming with, the first element, the second element, and having at least two electrodes be in electrical contact solely with the first element of the first and second elements, such that subjecting the first element to an electric potential via the at least two electrodes results in a strain induced by the first element on the second element.

Before proceeding with the details of the Applicant's present Response, including amendments, comments, and arguments made therein, to each of the above indicated items of the present Office Action, the Applicant desires to indicate his state of surprise and being highly perplexed at essentially the entire contents of the Examiner's present Office Action. With all due respect for the Examiner, from careful review of the entire contents of the Examiner's present Office Action, it appears that the Examiner apparently mistakenly by-passed and failed to properly acknowledge and take into account the contents of the Applicant's detailed preceding Response communication filed on May 15, 2002, including amendments, comments, and arguments made therein, to each of the items indicated by the Examiner in the previous Office Action of Mar. 13, 2002.

Specifically, several of the above listed items of the Detailed Action by the Examiner in the present Office Action are 'identical' to items of the Detailed Action by the Examiner in the preceding Office Action of Mar. 13, 2002. In particular, above listed items 1, 2, and 4, of the Detailed Action by the Examiner in the present Office Action are entirely identical, word-for-word, to items 1, 2, and 3, respectively, of the Detailed Action by the Examiner in the preceding Office Action of Mar. 13, 2002. Additionally, in particular, except for the Examiner's introduction of the White prior art reference, above listed item 5 of the Detailed Action by the Examiner in the present Office Action is identical, word-for-word, to item 4 of the Detailed Action by the Examiner in the preceding Office Action of Mar. 13, 2002.

In order to continue prosecution of this case in an organized and logical manner, hopefully, synchronized with the Examiner, with all due respect, the Applicant addresses each of the above listed items of the Detailed Action by the Examiner in the present Office Action, in view of the contents of the Applicant's detailed preceding Response communication filed on May 15, 2002, including amendments, comments, and arguments made therein.

As a reminder, by the preceding Response communication filed on May 15, 2002, the Applicant corrected 'obvious-to-correct' component reference number errors appearing in the text of the specification, on page 42, and, appearing in corresponding Figure 2. Independent claims 1 (device corresponding to the method recited by claim 29) and 29 (method corresponding to the device recited by claim 1) were amended. Claims 2 and 30, depending therefrom, respectively, were cancelled.

Rejection of Previous Newly Submitted Claims 29 - 31

This corresponds to above listed item 1 of the Detailed Action by the Examiner in the present Office Action, identical to and previously set forth as item 1 of the Detailed Action by the Examiner in the preceding Office Action of Mar. 13, 2002.

In each said Office Action, the Examiner withdrew claims 29 - 31 from consideration as being directed to a non-elected invention, according to 37 CFR 1.142(b) and MPEP 821.03. Therein, the Examiner gave several reasons for the withdrawal of these claims, which for brevity, are not repeated herein.

As stated in the Applicant's preceding Response communication filed on May 15, 2002, during said telephone interview, the Applicant explained to the Examiner that the intention of claims 29 - 31 was to read upon the method, fully supported by the originally filed specification, corresponding to recitations of claims 1 - 3 reading upon the device of the present invention. During same said telephone interview, the Applicant also explained to the Examiner that function/structure of the piezoelectric device (claims 1 - 3) and corresponding method thereof (claims 29 - 31), of the present invention, have absolutely nothing to do with vibrations and/or operation of surface wave filters referred to by the Examiner in said reasons of withdrawal of these claims.

During said telephone interview, in view of the Applicant's explanations, the Examiner agreed to the Applicant's request to amend claims 29 - 31 reading upon the method, in a way appropriately consistent and complementary to amendment of claims 1 - 3 reading upon the device, of the present invention. In view of the Applicant's amendment to claim 1, by the preceding Response communication of May 15, 2002, the Applicant amended claim 29, by including limitation of cancelled claim 30, using language appropriately consistent and complementary to that used in amended claim 1 therein. Specifically, the preamble of independent claim 29, reading upon the method of the present invention, was amended from reciting "A method of piezoelectrically inducing strain in an element" to reciting "A method of inducing a strain by a first element of porous crystalline silicon on a second element", thereby removing reference of "piezoelectrically" inducing a strain, along with providing recitation of claim 29 which was appropriately consistent and complementary to previous amendment of independent claim 1 including limitation of cancelled claim 2, reading upon the device of the present invention.

In view of the remarks and amendment therein, the Applicant submitted that amended claim 29 was in condition for allowance, and such action was respectfully and earnestly solicited. The Applicant cancelled claim 30. Additionally, in view of the preceding discussion therein, the Applicant submitted that claim 31, depending from allowable amended independent claim 29, was allowable in its present form and such action was respectfully requested.

As explained in more detail below, by the present Response, independent claim 1, reading upon the device of the present invention, has been amended in order to properly and completely overcome the second part of the Examiner's rejection of claims 1 - 3 under 35 U.S.C. 112, first paragraph, regarding the recitation in claim 1 that the device functions with at least "one electrode". By the present Response, amended claim 1 includes recitation, fully

supported by the original specification, as described below, whereby there are "at least two electrodes being in electrical contact solely with said first element of said first and second elements".

Accordingly, in order to maintain recitation of claim 29 reading upon the method as being consistent and complementary to recitation of claim 1 reading upon the device, by the present Response, amended claim 29 includes recitation, similarly fully supported by the original specification, as described below, whereby there are "at least two electrodes being in electrical contact solely with the first element of the first and second elements".

In view of the above remarks and amendment, by the present Response, the Applicant submits that amended claim 29 is in condition for allowance, and such action is respectfully and earnestly solicited. Additionally, in view of the preceding discussion, the Applicant submits that claim 31, depending from allowable amended independent claim 29, is allowable in its present form and such action is respectfully requested.

Objection to the Drawings

This corresponds to above listed item 2 of the Detailed Action by the Examiner in the present Office Action, identical to and previously set forth as item 2 of the Detailed Action by the Examiner in the preceding Office Action of Mar. 13, 2002.

In each said Office Action, the Examiner objected to the drawings under 37 CFR 1.83(a). Specifically, the Examiner stated that the "isolating channels such as spaces" disclosed in claim 2 must be shown or the feature(s) cancelled from the claim(s).

The Applicant respectfully reminds the Examiner that by the Applicant's preceding Response communication of May 15, 2002, claim 2 was cancelled. Additionally, as clearly stated in same said preceding Response communication, "as apparent from above Applicant's amendment of claim 1, by including limitation of now cancelled claim 2, excluding recitation

of the feature of "isolating channels such as spaces", for overcoming the Examiner's 35 U.S.C. 102(e) rejection of claim 1, this feature is thereby excluded and cancelled from the claims. In view of the preceding remarks, the Applicant submits that Examiner's objection to the drawings under 37 CFR 1.83(a) is completely overcome".

Thus, by the present Response, in view of the preceding remarks, the Applicant submits that Examiner's objection to the drawings under 37 CFR 1.83(a) is completely overcome.

35 U.S.C. 112, first paragraph Claims Rejections

The Examiner rejected claims 1 - 3 under 35 U.S.C. 112, first paragraph, as based on a disclosure which is not enabling. The Examiner's rejection is respectfully traversed.

In the first part of this rejection, the Examiner stated "The silicon having piezoelectrical properties is critical or essential to the practice of the invention, but not included in the claim(s) is not enabled by the disclosure". Additionally, the Examiner posed several specific questions about the contents of the disclosure relating to the description of the present invention, which for brevity, are not repeated herein.

The Applicant strongly contends that the specification as originally filed includes sufficient amounts of text and figures which provide general and specific enabling information and data, and evidence, relating to the use of silicon, crystalline silicon, and porous crystalline silicon, and piezoelectric properties, characteristics, and behavior, thereof, needed by one of ordinary skill in the art to properly reduce the present invention to practice.

Specifically, the Examiner's attention is directed to the specification on page 30, line 18, to page 31, line 12, along with reference to FIG. 3, which describe and illustrate the dependence of the elevation or expansion of silicon-porous silicon bimorph mirror on voltage, as an exemplary embodiment of the present invention recited by claims 1 and 29.

Additionally, the Examiner's attention is directed to the specification on page 31, lines 13 - 16, along with reference to FIGS. 4a-b, which graphically illustrates typical dependence of the curvature (Zernike defocus coefficient) of the wafer, of the silicon-porous silicon bimorph mirror, on the voltage for two samples. Therein, are sufficiently enabling details, of materials of construction and a constant of design, dimensions and quantities thereof, and conditions thereof, describing the process of manufacturing and operating the silicon-porous silicon bimorph mirror. Moreover, FIG. 5 provides a simplified, but very clear and enabling perspective view of a preferred embodiment of the piezoelectric device according to the present invention, as described in the specification on page 34, lines 3 - 18, and as recited by claims 1 and 29.

Specifically, the Examiner's attention is directed to the specification on page 33, lines 3 to 15, wherein there is provided several well known and readily available references in the art of crystalline silicon, in general, and in the art of porous crystalline silicon, in particular, which contain therein all the necessary enabling information and data for one of ordinary skill in the art to properly reduce the present invention to practice. The Applicant respectfully reminds the Examiner that the present invention, as illustratively described in the specification and recited by the claims, is "derived from a striking novel discovery, that porous crystalline (silicon, in particular) materials have piezoelectric and piezoelectric properties", and, that "The present invention, therefore, relates to devices and methods which take advantage of this newly discovered phenomenon", as clearly stated in the specification on page 1, lines 24 - 27. Accordingly, the present invention is not about techniques, which are widely taught about in the art, for converting silicon to porous crystalline silicon, nor about well known porous crystalline silicon itself, but, rather about devices and corresponding methods thereof, utilizing structure/function of porous crystalline silicon for exhibiting the newly discovered

piezoelectric and piezooptic properties and behavior of the porous crystalline silicon under conditions described in the specification.

Specifically, the Examiner's attention is directed to the specification on page 38, line 12, to page 39, line 16, where, in *EXAMPLE 1*, there is provided sufficiently enabling details, of materials of construction and a constant of design, dimensions and quantities thereof, and conditions thereof, describing "*Construction of a mirror*", and operation thereof, as an exemplary preferred embodiment of the present invention, recited by claims 1 and 29.

Specifically, the Examiner's attention is directed to the specification on page 40, line 1, to page 42, line 9, where, in *EXAMPLE 2*, there is provided detailed enabling description of "*Theoretical considerations*" explaining and mathematically modeling the newly discovered piezoelectric properties, characteristics, and behavior, exhibited by porous crystalline silicon. For example, therein, on page 41, line 3, to page 42, line 9, there is a detailed mathematical description of modeling "the dependence of strain on voltage". Therein are also provided several well known and readily available references, which contain therein additional enabling information and data for one of ordinary skill in the art to properly reduce the present invention to practice.

Specifically, the Examiner's attention is directed to the specification on page 42, line 10, to page 46, line 2, along with reference to FIG. 2, where, in *EXAMPLE 3*, there is provided detailed enabling illustrative description of "*An optical system incorporating the mirror*" of previously described *EXAMPLE 1*, as an exemplary implementation of the present invention. For example, therein, on page 44, line 10, to page 45, line 15, there is detailed description, including explanation, of "the processes of the piezoelectric and electrostrictive response of the porous silicon" in relation to "the measured strain" induced by the porous silicon. Therein is also provided a well known and readily available reference containing additional enabling

information and data for one of ordinary skill in the art to properly reduce the present invention to practice.

Thus, by the present Response, in view of the preceding remarks, the Applicant contends that the specification as originally filed includes sufficient amounts of text and figures which provide general and specific enabling information and data, and evidence, relating to the use of silicon, crystalline silicon, and porous crystalline silicon, and piezoelectric properties, characteristics, and behavior, thereof, needed by one of ordinary skill in the art to properly reduce the present invention to practice. Accordingly, the Applicant submits that this first part of the Examiner's rejection to the claims under 35 U.S.C. 112, first paragraph, is completely overcome.

In the second part of the above indicated rejection of the claims under 35 U.S.C. 112, first paragraph, the Examiner stated "Moreover, about claim 1, it discloses that the device functions with at least "one electrode", that is, the invention may function with one electrode; however, such device would not be operate since no potential difference could be establish (one electrode) and a piezoelectric device needs at least two electrodes to function properly, otherwise, the electrical charge would be unbalanced with just one electrode".

By this Response, in order to expedite the prosecution, the Applicant has amended each occurrence of the phrase "one electrode", and of the phrase "electrode(s)", in the specification, to read "two electrodes", and "electrodes", respectively. Specifically, the Applicant has accordingly amended four paragraphs of text of the specification; two paragraphs on page 24, and one paragraph on each page 34 and 37. Additionally, the Applicant has accordingly amended independent claim 1 (device corresponding to the method recited by claim 29) and claim 29 (method corresponding to the device recited by claim 1). Changes made to the specification and claims by these amendments are clearly shown in the

marked up version, captioned "Version With Markings To Show Changes Made", attached herein below.

Support for these amendments is clearly and repeatedly found throughout the entire specification, including in the description and accompanying figures, as originally filed.

Specifically, in the specification on page 30, line 18, to page 31, line 12, along with reference to FIG. 3, wherein there is description of construction and operation of the silicon-porous silicon bimorph mirror, as an exemplary embodiment of the present invention recited by claims 1 and 29. Therein, it is clearly stated that "Two wires (that is, two electrodes) were attached by silver paint to the porous surface and one (wire) to the front aluminized surface, serving as ground. The diameter of the wafer was 51 mm, of the porous silicon 26 mm, and of each electrode 2 mm. The visible section shows 15 mm of the sample, with two electrodes, one at the bottom right of this section and one at the top left".

Specifically, in the specification on page 34, lines 8 - 12, along with reference to FIG. 5, with respect to the piezoelectric device of the present invention, as recited by claim 1, wherein it is clearly described and illustrated that "Device **60** further includes a second element **64** which is attached to, or integrally formed with, first element **62**. Device **60** further includes at least one electrode **66** (three are shown) which is in electrical contact with first element **62**. The arrangement of the above components is selected such that subjecting first element **62** to an electric potential via electrode(s) **66** results in a strain induced by first element **62** on second element **64**.

Specifically, in the specification on page 34, lines 12 - 18, along with reference to FIG. 5, with respect to the corresponding method of the present invention, as recited by claim 29, wherein it is clearly described and illustrated that "A method of producing a piezoelectric device according to the present invention is effected by attaching to, or integrally forming with, a first element (**62**) of porous crystalline material, a second element (**64**), and attaching

to the first element (**62**) at least one electrode (**66**), such that subjecting the first element (**62**) to an electric potential via the electrode(s) (**66**) results in a strain induced by the first element (**62**) on the second element (**64**).

Specifically, in the specification on page 37, lines 1 - 4, along with reference to FIG. 7, with respect to another exemplary embodiment of the present invention, wherein it is clearly described and illustrated that "According to a presently preferred embodiment of the present invention, and as is further shown in Figure 7, adaptive reflector **80** further includes at least one electrode **88**, through which an electric potential is applicable to first layer **82**". The Applicant directs the Examiner's attention to the fact that two electrodes **88** are clearly shown in the exemplary embodiment of the present invention illustrated in FIG. 7.

Specifically, in the specification on page 37, lines 7 - 11, wherein there is description of the important relationship between the structure of the porous crystalline material and its piezoelectric response. Therein, it is clearly stated that "In low-porosity materials, the residual matter is not made of separate islands, and thus its conduction is high and the application of voltage to it results in short-circuiting between the electrodes (percolation)".

Specifically, in the specification on page 39, lines 8 - 11, in *EXAMPLE 1*, of the detailed description of the "*Construction of a mirror*", and operation thereof, as an exemplary preferred embodiment of the present invention, recited by claims 1 and 29. Therein, it is clearly stated that "Electrodes were then made on the porous silicon. As is further exemplified hereinunder, application of voltage between the different electrodes and between the electrodes and the silicon wafer (whose resistance is negligible) . . . ".

Specifically, in the specification on page 40, line 13, in *EXAMPLE 2*, of the description of "*Theoretical considerations*" explaining and mathematically modeling the newly discovered piezoelectric properties, characteristics, and behavior, exhibited by porous

crystalline silicon. Therein, it is clearly stated that ". . . where $V(\mathbf{r})$ is a continuous description of the voltage on the electrodes".

Specifically, in the specification on page 44, lines 10 - 13, in the description and explanation of "the processes of the piezoelectric and electrostrictive response of the porous silicon" in relation to "the measured strain" induced by the porous silicon. Therein, it is clearly stated that "The piezoelectric and electrostrictive response of the porous silicon can be attributed to a number of processes, the foremost of which is electrostatics pull between the porous crystalline material under the electrodes".

Thus, by the present Response, in view of the preceding remarks and amendments, the Applicant contends that the specification as originally filed includes sufficient amounts of text and figures which provide general and specific enabling information and data, and evidence, needed by one of ordinary skill in the art to properly reduce the present invention to practice, regarding the structure and function of the piezoelectric device and corresponding method of the present invention, including "at least two electrodes being in electrical contact solely with said/the first element of said/the first and second elements, such that subjecting said/the first element to an electric potential via said/the at least two electrodes results in a strain induced by said/the first element on said/the second element", as recited by amended independent claim 1 (device corresponding to the method recited by claim 29) and amended independent claim 29 (method corresponding to the device recited by claim 1). Accordingly, the Applicant submits that this second part of the Examiner's rejection to the claims under 35 U.S.C. 112, first paragraph, is completely overcome.

Thus, by the present Response, in view of the preceding remarks and amendments, the Applicant submits that the Examiner's rejection to the claims under 35 U.S.C. 112, first paragraph, is completely overcome, whereby claims 1 and 29 and are therefore in allowable condition and such action is respectfully requested.

In view of the preceding discussion, the Applicant submits that claim 3, depending from allowable amended independent claim 1, and that claim 31, depending from allowable amended independent claim 29, are allowable in their present forms and such action is respectfully requested.

35 U.S.C. 102(e) Rejection - Takeuchi

This corresponds to above listed item 4 of the Detailed Action by the Examiner in the present Office Action, identical to and previously set forth as item 3 of the Detailed Action by the Examiner in the preceding Office Action of Mar. 13, 2002.

In each said Office Action, the Examiner rejected claim 1 under 35 U.S.C. 102(e) as being anticipated by Takeuchi. The Examiner's rejection is respectfully traversed.

The Applicant respectfully reminds the Examiner that by the Applicant's preceding Response communication of May 15, 2002, including reference to the above indicated telephone interview discussion between the Attorney for the Applicant and the Examiner, the Applicant amended claim 1 to include the limitations of canceled claim 2, thereby rendering moot the Examiner's rejection of claim 1 under 35 U.S.C. 102(e).

Thus, by the present Response, in view of the preceding remarks and amendments, the Applicant submits that the Examiner's rejection to claim 1 under 35 U.S.C. 102(e) is completely overcome, and that amended claim 1 is therefore in allowable condition and such action is respectfully requested.

35 U.S.C. 103(a) Rejection

This corresponds to above listed item 5 of the Detailed Action by the Examiner in the present Office Action, which, except for the Examiner's introduction of the White prior art reference in this claims rejection of the present Office Action, is identical to and previously

set forth as item 4 of the Detailed Action by the Examiner in the preceding Office Action of Mar. 13, 2002.

In the present Office Action, the Examiner rejected claims 2 and 3 under 35 U.S.C. 103(a) as being unpatentable over Takeuchi in view of Seefeldt et al. and White. The Examiner's rejection is respectfully traversed.

The Applicant respectfully reminds the Examiner that by the Applicant's preceding Response communication of May 15, 2002, including reference to the above indicated telephone interview discussion, the Applicant amended claim 1 to include the limitations of canceled claim 2, thereby focusing the present prosecution on previously amended claim 1 and on claim 3.

In each said Office Action, the Examiner stated that "Seefeldt discloses for the purpose of accurately measuring low force changes, a piezoelectric device comprising a first silicon porous material 138, a second element made of crystal 62 attached to first element, and at least one electrode 114 being in electrical contact with first element (see figure 25), such that subjecting first element to an electric potential results in strain induced by first element on second element (column 4, lines 54-58 and column 5, lines 53, 62, 63 and column 6, lines 3-7)".

In each said Office Action, the Examiner further stated that "It would have been obvious to one having ordinary skill in the art at the time the invention was made to design a piezoelectric device as disclosed by Takeuchi et al. and to modify the invention by using certain material for the first element for the purpose of accurately measuring low force changes as disclosed by Seefeldt".

By the present Response, herein, the Applicant respectfully reiterates selected relevant remarks and arguments of the Applicant's preceding Response communication of May 15, 2002, including reference to the above indicated telephone interview discussion, for

overcoming the Examiners rejection of claims 2 and 3 under 35 U.S.C. 103(a) as being unpatentable over Takeuchi in view of Seefeldt et al..

The Applicant of the present invention strongly contends that the Examiner is clearly incorrect by using the Seefeldt disclosure for 'attempting' to show unpatentability, based on obviousness, of the piezoelectric device of the present invention as recited by previously amended claim 1. In particular, the Applicant strongly contends that it certainly would not have been obvious, and that there would have been absolutely no motivation to one having skills in the art to use the sacrificial 'intermediate' or 'precursor' layer of "porous silicon" disclosed by Seefeldt for forming a force transducer, because, until the findings that led to the development of the present invention were uncovered, no artisan knew that porous silicon has piezoelectric characteristics.

In the disclosure of Seefeldt, with reference to the figures indicated therein, in column 4, lines 54 - 58, as cited by the Examiner, it is stated ". . . end portions 70 allows strain in the epitaxial layer 60 (or in the substrate 14) in the direction of the longitudinal axis 66 of the beam 62 to change the resonant frequency of the beam 62. In the specific embodiment illustrated, the beam 62 is part of the epitaxial layer 60 . . . "; in column 5, lines 62 - 63, as cited by the Examiner, it is stated "The transducer 10 includes means for measuring resonating motion of the beam 62"; and, in column 6, lines 3 - 7, as cited by the Examiner, it is stated "The resistance of the piezoresistor 122 changes with strain in the beam 62 in accordance with the piezoresistive effect, and thus permits resonance of the beam 62 to be measured in a known manner".

It ought to be absolutely clear to one of ordinary skill in the art, that by carefully reading and properly understanding the Seefeldt disclosure, that each of the preceding citations by the Examiner relates to describing operation of the 'completely' formed force transducer 10 only, as disclosed therein in relatively expansive illustrative detail. The force

transducer 10 of Seefeldt is completely formed only after implementing a tedious multi step-by-step procedure, as disclosed therein, involving a long series of multiple steps and sub-steps following the steps of physicochemically converting and removing the porous silicon layer from the precursor structure of the force transducer.

Equally stated, the cited Seefeldt invention involves porous silicon 'exclusively' during intermediate processing steps used 'only' for producing intermediate precursor structures during the forming of the force transducer 10. The produced force transducer 10 device clearly and definitely has no porous silicon in its structure, and therefore, there is no 'obviously' derived role or function of porous silicon during operation of the force transducer involving inducing strain for causing change in the resonant frequency of the beam 62.

Support for this contention by the Applicant is clearly found throughout the entire Seefeldt disclosure, especially with reference to description relating to formation of the transducer 10, as indicated in column 6, lines 25 - 46. Therein, it is stated "5. forming porous silicon of the p-type layer 138 and the p-type sinkers 142 by anodization; 6. oxidizing the porous silicon to form silicon dioxide in three pre-cavity regions;".

Additionally, in column 8, lines 31 - 33, wherein it is stated "The p-type layer 138 and the p-type sinkers 142 are anodized to form a pre-cavity region consisting of porous silicon". Additionally, in column 8, lines 47 - 51, wherein it is stated "The porous silicon thus defines a pre-cavity region in the area previously occupied by the p-type layer 138 and p-type sinkers 142. The porous silicon in the pre-cavity region is oxidized to form silicon dioxide". Additionally, in column 8, lines 60 - 64, wherein it is stated "Upon oxidation, the porous silicon in the pre-cavity region is converted to silicon dioxide, and a layer of silicon dioxide having a thickness of about 1500 angstroms is incidentally formed over the entire upper surface of the n-type epitaxial layer 60; and, in column 9, lines 55 - 57, wherein it is stated

"The porous silicon dioxide in the pre-cavity regions is removed or dissolved by etching to form the cavities 22, 46 and 50".

During this stage of the disclosed procedure for forming the transducer 10, the intermediate porous silicon layer is chemically converted to another form, that is, to an intermediate porous silicon dioxide layer, and is therefore no longer present during the many subsequent steps and sub-steps for forming the transducer 10, and, thus, the porous silicon layer is not present during operation of the force transducer 10.

Moreover, throughout the entire disclosure of Seefeldt, there is no direct or indirect description, suggestion, or, hint, and, therefore, there is no motivation by one of ordinary skill in the art, of using the "porous silicon" disclosed by Seefeldt, other than as an intermediate or precursor layer or structure, needed for forming the pre-cavity and subsequent cavity regions, en route for producing the forced transducer 10 in a ready and operational form.

Indeed, with regard to using porous silicon as part of an intermediate or precursor layer or structure, porous silicon is formed in many micromachining processes as a sacrificial layer of precursor structures of electronic devices, ordinarily used to produce an empty volume in a later or subsequent step for forming a finished structure or device, such as the previously cited pre-cavity regions in the intermediate precursor structures of the force transducer described in the Seefeldt disclosure, as well as intermediate precursor structures described in the other prior art previously cited by the Examiner, for example, in Iwata et al. (U.S. Patent No. 5,665,250), Yagi et al. (U.S. Patent No. 6,143,190), and, Seefeldt et al. (U.S. Patent No. 5,834,333), and, taught about in the Applicant's cited prior art, for example, as referenced on p. 33, in particular, and, throughout the Field and Background section, in the specification of the present invention.

Thus, by respectfully reiterating to the Examiner, the Applicant strongly contends that it certainly would not have been obvious, and that there would have been absolutely no

motivation to one having skills in the art to use the sacrificial 'intermediate' or 'precursor' layer of "porous silicon" disclosed by Seefeldt for forming a force transducer, in a modification of the piezoelectric device disclosed by Takeuchi et al., because, until the findings that led to the development of the present invention were uncovered, no artisan knew that porous silicon has and exhibits piezoelectric properties and characteristics.

In the present Office Action, regarding this 35 U.S.C. 103(a) claims rejection, the Examiner further stated that "However, neither Tekeuchi nor Seefeldt disclose explicitly that silicon may be used to induced other elements. On the other hand, White discloses for the purpose of providing devices that produce minimal electrical interferences that silicon may be used to induced other elements when a voltage is applied to silicon (abstract & column 2, lines 48 - 55).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to design a piezoelectric device as disclosed by Takeuchi et al. and to modify the invention by using certain material for the first element for the purpose of accurately measuring low force changes as disclosed by Seefeldt and to use silicon to induced other material for the purpose of providing devices that produce minimal electrical interferences as disclosed by White".

By the present Response, the Applicant of the present invention strongly contends that the Examiner is clearly incorrect by using the White disclosure, in view of Tekeuchi and Seefeldt, for 'attempting' to show unpatentability, based on obviousness, of the piezoelectric device of the present invention as recited by previously (and presently) amended claim 1. In particular, the Applicant strongly contends that it certainly would not have been obvious, and that there would have been absolutely no motivation to one having skills in the art to use the "dielectric layer such as silicon nitride situated between a conductive ground plane and a transducer electrode having two or more conductors that are spaced one wave length apart"

disclosed by White, in a modification of the piezoelectric device disclosed by Tekeuchi, in view of the invention disclosed by Seefeldt, for inducing motion or strain on other materials, such as on the "second element" as recited in claim 1 reading upon the piezoelectric device of the present invention.

This contention is based on the fact that the piezoelectric device of the present invention, as recited by claim 1 and illustratively described in the specification, neither has nor requires a transducer or transducer electrode, for initiating or activating the "strain induced by the first element on the second element". That is, the main aspect of novelty and inventiveness of the present invention is that the porous crystalline silicon material, itself, is the sole component of the piezoelectric device wherein the piezoelectric properties, characteristics, and behavior, are exhibited, without any direct or indirect operative interaction or contact with a separately activated piezoelectric or electrorestrictive type of component, such as the separately activated "ultrasonic transducer electrode" required for "causing an ultrasonic membrane wave action" of the silicon nitride membrane in the micromotor device disclosed by White. As a matter of fact, the micrometer device disclosed by White cannot at all function in the absence of a separately activated ultrasonic transducer electrode component directly in contact with the membrane layer such as the silicon nitride membrane.

N.I.C

By strong contrast, operation of the piezoelectric device and corresponding method of the present invention involves "subjecting the first element (porous crystalline silicon) to an electric potential via said at least two electrodes results in a strain induced by the first element on the second element", since the second element is attached to, or integrally formed with, the first element (porous crystalline silicon), and at least two electrodes are in electrical contact solely with the first element (porous crystalline silicon) of the first and second elements, as clearly recited by amended claims 1 and 29, reading upon the piezoelectric device and corresponding method of the present invention. **Clearly, recitations of claims 1 and 29 of**

the present invention are not obviously derived, directly or indirectly, from the inventions disclosed by Tekeuchi and Seefeldt, in view of the ultrasonically activated and operative silicon nitride membrane in the micrometer device disclosed by White.

The Applicant submits, therefore, that the preceding remarks and argument completely overcome the Examiner's rejection to claim 2 based on grounds of 35 U.S.C. 103(a).

In view of the above Applicant's amendments of claim 1, for overcoming the Examiner's 35 U.S.C. 112, first paragraph rejection of claims 1 - 3, and for overcoming the Examiner's 35 U.S.C. 102(e) rejection of claim 1, and, in view of the preceding Applicant's argument for overcoming the Examiner's 35 U.S.C. 103(a) rejection of claim 2, the Applicant submits that presently amended claim 1, including limitation of cancelled claim 2, is in condition for allowance, and such action is respectfully and earnestly solicited.

In view of the preceding discussion, the Applicant submits that claim 3, depending from allowable amended independent claim 1, is allowable in its present form and such action is respectfully requested.

In view of the above remarks and amendments therein, the Applicant submits that amended claim 29 (method corresponding to the device recited by amended claim 1) is in condition for allowance, and such action is respectfully and earnestly solicited. Accordingly, in view of the preceding discussion, the Applicant submits that claim 31, depending from allowable amended independent claim 29, is allowable in its present form and such action is respectfully requested.

Hetrick (U.S. Patent No. 4,806,859), and, Van Vooren et al. (U.S. Patent No. 6,126,273), cited by the Examiner in PTO-892, have been carefully reviewed, but are deemed not to render the Applicant's invention unpatentable, either singly or in combination, as was properly determined by the Examiner in the present Office Action.

By this Response, the Applicant respectfully submits that independent claims 1 and 29, and hence dependent claims 3 and 31, respectively, are now in condition for allowance, and such action is respectfully and earnestly solicited.

The Applicant respectfully requests that a timely Notice of Allowance be issued in this case.

Respectfully submitted,

Sol Sheinbein
Attorney for Applicant
Registration No. 25,457

Date: August 18, 2002

Encl.:
1. VERSION WITH MARKINGS TO SHOW CHANGES MADE.

VERSION WITH MARKINGS TO SHOW CHANGES MADE

Text in bold brackets, [xxxx], means that the bracketed letter, word, phrase, or section, has been 'deleted' / 'cancelled' from the indicated original Specification / claim, and 'does not' appear in the indicated replacement (amended) Specification / claim. Underlined text, xxxx, means that the letter, word, phrase, or section, has been 'added' to the indicated original Specification / claim, and 'does' appear in the indicated replacement (amended) Specification / claim.

In the Specification:

The paragraph beginning at line 2 of page 24 has been amended as follows:

According to one aspect of the present invention there is provided a piezoelectric device comprising a first element of porous crystalline material, a second element being attached to, or integrally formed with, the first element, and at least [one electrode] two electrodes being in electrical contact with the first element, such that subjecting the first element to an electric potential via the at least [one electrode] two electrodes results in a strain induced by the first element on the second element.

The paragraph beginning at line 9 of page 24 has been amended as follows:

According to another aspect of the present invention there is provided a method of producing a piezoelectric device comprising the steps of attaching to, or integrally forming with, a first element of porous crystalline material, a second element, and attaching to the first element at least [one electrode] two electrodes , such that subjecting the first element to an

electric potential via the at least [one electrode] two electrodes results in a strain induced by the first element on the second element.

The paragraph beginning at line 3 of page 34 has been amended as follows:

Figure 5 shows a piezoelectric device in accordance with the teachings of the present invention, which is referred to hereinbelow as device **60**. Device **60** includes a first element **62**. Element **62** is of porous crystalline material, such as, but not limited to, porous silicon. Device **60** further includes a second element **64** which is attached to, or integrally formed with, first element **62**. Device **60** further includes at least [one electrode] two electrodes **66** (three are shown) which is in electrical contact with first element **62**. The arrangement of the above components is selected such that subjecting first element **62** to an electric potential via [electrode(s)] electrodes **66** results in a strain induced by first element **62** on second element **64**. A method of producing a piezoelectric device according to the present invention is effected by attaching to, or integrally forming with, a first element **62** of porous crystalline material, a second element **64**, and attaching to the first element (**62**) at least [one electrode] two electrodes **66**, such that subjecting the first element **62** to an electric potential via the [electrode(s)] electrodes **66** results in a strain induced by the first element **62** on the second element **64**.

The paragraph beginning at line 1 of page 37 has been amended as follows:

According to a presently preferred embodiment of the present invention, and as is further shown in Figure 7, adaptive reflector **80** further includes at least [one electrode] two electrodes **88**, through which an electric potential is applicable to first layer **82**. According to an alternative embodiment, adaptive reflector **80** further includes at least one light source **89** with which light is applicable to first layer **82**.

In the Claims:

Claims 1 and 29 have now been amended as follows:

1. (Amended) A piezoelectric device comprising a first element of porous crystalline silicon, a second element being attached to, or integrally formed with, said first element, and at least [one electrode] two electrodes being in electrical contact solely with said first element of said first and second elements, such that subjecting said first element to an electric potential via said at least [one electrode] two electrodes results in a strain induced by said first element on said second element.

29. (Amended) A method of inducing a strain by a first element of porous crystalline silicon on a second element, the method comprising the steps of attaching to, or integrally forming with, the first element, the second element, and having at least [one electrode] two electrodes being in electrical contact solely with the first element of the first and second elements, such that subjecting the first element to an electric potential via said at least [one electrode] two electrodes results in a strain induced by the first element on the second element.